

# *High prevalence of undernutrition and low dietary diversity in institutionalised elderly living in Sri Lanka*

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**Title:** High prevalence of undernutrition and low dietary diversity in institutionalised elderly living in Sri Lanka

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**Keywords:** institutionalised elderly, undernutrition, dietary diversity, geriatric care

**Running title:** Undernutrition of institutionalised elderly

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Ethical clearance for this study was obtained from the Ethical Review Committee of the Sri Lanka Medical Association (ERC/13-037).

32   **Abstract**

33   **Objective:** The study aimed to assess nutrition status, dietary diversity and lifestyle risk factors  
34   associated with undernutrition in an institutionalised Sri Lankan elderly population.

35   **Design:** The study was of cross-sectional design followed by a stratified sampling method.

36   **Setting:** Twelve homes for the elderly recruited from six provinces in Sri Lanka.

37   **Subjects:** A total of 311 institutionalised elderly age  $\geq 60$  years.

38   **Results:** The mean (SD) age of the study population was 74.4 (7.8) years. Prevalence of  
39   undernutrition was 30%. Mean (SD) food variety score, dietary diversity score and dietary serving  
40   score of the study population were 8.7 (1.5), 7.3 (1.2) and 10.9 (2.0), respectively. Mean daily  
41   intakes of fruit, vegetables, meat, fish, eggs and pulses and dairy portions were below the national  
42   recommendations, whereas the mean consumption of sugar exceeded the national recommendation.  
43   Only the mean intake of starch was within the recommendation. Food allergies (OR=8.0; 95% CI  
44   3.9, 16.2), skipping meals (OR=3.8; 95% CI 2.0, 7.5) and lack of leisure activities (OR=3.1; 95%  
45   CI 1.5, 6.7) significantly increased the risk of undernutrition, whereas the use of dentures decreased  
46   the risk (OR=0.20; 95% CI 0.06, 0.69).

47   **Conclusions:** High prevalence of undernutrition and low dietary diversity were observed in an  
48   institutionalised elderly Sri Lankan population. Therefore, there is an urgent need to implement  
49   nutrition interventions as part of geriatric care to reduce undernutrition and improve the diets of the  
50   institutionalised elderly population in Sri Lanka.

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## 63 **Introduction**

64 Globally, prevalence of the elderly population (>60 years) has gradually increased over the past few  
65 decades. In Sri Lanka it accounts for 12.3% of the total population<sup>(1)</sup>, which is the fastest growing  
66 elderly population in South East Asia<sup>(2, 3)</sup>. It is well-documented that worldwide there is a higher  
67 prevalence of malnutrition in the institutionalised elderly compared with the free-living elderly<sup>(4-7)</sup>.  
68 Existing literature suggests that nutritional status has a major impact on the health and functional  
69 status of older individuals. Furthermore, biological, physiological, social and psychological changes  
70 often accompanied with aging along with increased prevalence of morbidities enhance the  
71 susceptibility of the elderly to be malnourished<sup>(8)</sup>. The aetiology of malnutrition is multifactorial in  
72 older people. Evidence indicates that the elderly are at a risk of nutritional deficiencies due to  
73 changes in body composition, the gastrointestinal tract, sensory function, and fluid and electrolyte  
74 regulation, and from chronic illness, medication, hospitalisation and psychosocial factors, such as  
75 financial restrictions, social isolation, widowhood and bereavement, food anxieties and decreasing  
76 independence<sup>(9)</sup>. Nutritional status is a key determinant of quality of life, morbidity and mortality of  
77 older people.

78 In Sri Lanka, pre and primary school children, adolescents and pregnant mothers are recognised as  
79 nutritionally vulnerable populations. Sri Lanka and other counties are currently experiencing an  
80 increasing aging population as a result of declining fertility and mortality rates. Siddhisena reported  
81 that during the last two decades the number of institutionalised older people has risen considerably  
82 suggesting a growing demand for care<sup>(10)</sup>. Furthermore, recent studies performed in India and  
83 Malaysia showed a higher prevalence of malnutrition in the institutionalised elderly<sup>(4, 11)</sup>. It is  
84 evident that the elderly, particularly those who are institutionalised, require specific attention and  
85 should be a priority in public health nutrition intervention programmes. Thus, the prevalence and  
86 risk factors associated with undernutrition in different elderly populations needs to be investigated  
87 to determine suitable nutritional therapies to combat undernutrition in these population groups. The  
88 study aim was to assess nutrition status, dietary diversity and lifestyle risk factors associated with  
89 undernutrition in an institutionalised elderly population from Sri Lanka.

## 91 **Methods**

### 92 **Study design and participants**

93 This study was conducted with a cross-sectional design followed by a stratified sampling method.  
94 Ethical clearance was obtained from the Ethical Review Committee of the Sri Lanka Medical  
95 Association (ERC/13-037). The study aimed to recruit 300 elderly men and women, with an  
96 expected prevalence of 20%, with a power of 95% and a 5% significance level, which included a  
97 drop-out rate of 10%<sup>(12)</sup>. A total of 311 older adults (age  $\geq 60$  years) were recruited from 12 homes

98 for the elderly from six provinces, which were considered as primary units, in Sri Lanka. The six  
99 provinces were Western, North Western, Sabaragamuwa, Central, Northern and Eastern province. A  
100 list of all registered elders' homes in each province were obtained from the relevant provincial  
101 social services departments and from this list two elderly homes were randomly selected as  
102 secondary units. Subjects were purposively included who could communicate, did not have any  
103 cognitive impairment and were able to carry out a face-to-face interview for approximately 40  
104 minutes. The selected elderly homes were initially contacted via telephone by the study team who  
105 explained the study and verbal consent was taken. Elderly homes were randomly visited (including  
106 both week and weekend days) to minimize data bias. All subjects provided written informed  
107 consent prior to data collection. An interviewer-administered questionnaire was used to collect  
108 information regarding socio-demographic status (age, gender, level of education and financial  
109 status), physiological factors (appetite loss, tooth loss, use of dentures and vision impairment),  
110 psychological factors (presence of depression as defined by lack of interest or pleasure in life, lack  
111 of engagement with friends, caregivers and day to day activities, low mood and frequent negative  
112 thoughts), lifestyle factors (ability to move, leisure activities, usage of medication and betel  
113 chewing) and dietary risk factors (skipping meals, ability to eat and food allergy). The presence of  
114 food allergy was self-reported and not necessarily clinically diagnosed.

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## 116 **Anthropometry**

117 Anthropometric measurements, including height, body weight, mid upper arm circumference  
118 (MUAC) and calf circumference (CC), were obtained by trained investigators using standard  
119 equipment according to standard guidelines<sup>(13)</sup>. Participants were asked to remove jackets, shoes,  
120 and jewellery and empty their pockets, before body weight was measured using a calibrated  
121 electronic scale (Seca 813, Hamburg, Germany), accurate to the nearest 0.1 kg, which was placed  
122 on an even concrete floor. Height was measured to the nearest 0.1 cm with an upright plastic  
123 portable stadiometer (Invicta Plastics-Model IP0955, Leicester, UK) while the subject was in a  
124 standing position without footwear. BMI was calculated as weight divided by height<sup>2</sup> (kg/m<sup>2</sup>).  
125 According to the WHO cut-off values for Asians, a BMI of  $\leq 18.5$  kg/m<sup>2</sup> is considered a marker of  
126 undernutrition<sup>(14)</sup>. A non-stretchable measuring tape was used to assess the MUAC, which was  
127 taken at the midpoint between the acromial process of the scapula and olecranal process of the  
128 elbow of the non-dominant arm when the forearm was hanging relaxed at the side. The two  
129 categories of MUAC were  $< 21$  cm and  $\geq 21$  cm, with  $< 21$  cm being an indicator of undernutrition<sup>(15)</sup>.  
130 CC, considered the most sensitive measure of muscle mass in the elderly<sup>(16)</sup>, was measured with the  
131 subject sitting in a chair with the knee and corresponding ankle kept bent to a 90° angle. The  
132 researcher knelt beside the lateral side of the left calf and a loop of measuring tape was placed

133 around the calf. When the largest circumference was located, by moving the loop up and down the  
134 calf, the tape was pulled snugly around the calf. This measurement was recorded to the nearest 0.1  
135 cm and two consecutive measurements were taken and the mean circumference recorded<sup>(15)</sup>. As  
136 categorised in the mini-nutritional assessment tool (MNA)<sup>(17)</sup>, the two categories of CC were set as:  
137 1) <31 cm and 2) 31 or >31 cm.

138

### 139 **Dietary diversity**

140 A single 24-h dietary recall was used to assess dietary intake. The recalls were taken on random  
141 days (week or weekend day) by a trained researcher to minimise day-to-day variation. All foods and  
142 drinks consumed on the previous day were obtained in direct chronological order by following the  
143 standard protocol of multiple-pass recalling technique<sup>(18)</sup>. In addition, a detailed description of the  
144 foods, cooking method and brand names of some foods, such as milk and processed foods, were  
145 recorded. Food intake was obtained using standard household measures, such as coconut spoons,  
146 tablespoons, teaspoons, bowls, glasses and teacups. To assist the subjects in accurately reporting the  
147 intake of foods, a series of food portion size photographs and food models prepared by the  
148 researcher were shown. For each subject, all food and drink items consumed were assigned to one  
149 of the major food groups as described in Sri Lankan food-based dietary guidelines<sup>(19)</sup>. Those food  
150 groups were: 1) cereal or equivalents (starchy foods), 2) vegetables, 3) fruits, 4) meat, fish, eggs and  
151 pulses, 5) dairy and 6) added sugars. The quantity of household measures for one serving of food in  
152 the selected food groups were obtained as defined by Jayawardena *et al*<sup>(20)</sup>. For each food group, the  
153 quantity of household measures of food consumed was divided by the quantity of household  
154 measure for one serving and summed to derive the total number of servings consumed. Composite  
155 food dishes were disaggregated into its ingredients and those ingredients were assigned to the  
156 appropriate food groups for calculating the number of servings. The dietary diversity of the study  
157 population was assessed by a food variety score (FVS; a simple count of food items consumed),  
158 dietary diversity score (DDS; a simple count of food groups consumed out of 12 groups considered)  
159 and dietary serving score (DSS; number of portions of different food groups in conformity with  
160 dietary guidelines of Sri Lanka)<sup>(21)</sup>.

161

### 162 **Data analysis**

163 Data were analysed using SPSS version 21 (SPSS Inc. Chicago, IL, USA). In all analyses, a P-value  
164 <0.05 was considered as statistically significant. Both univariable and multivariable logistic  
165 regression analyses were performed to determine the risk factors associated with undernutrition.  
166 Data presented represent mean (standard deviation; SD), unless otherwise specified.

167

## 168 Results

169 The study sample consisted of 45% men (n=140) and 55% women (n=171). The mean (SD) age of  
170 the study population was 74.4 (7.8) years. The socio-demographic and anthropometric  
171 characteristics of the study population are shown in Table 1. The mean (SD) BMI, MUAC and CC  
172 of the subjects were 21.5 (4.8) kg/m<sup>2</sup>, 23.4 (3.5) cm and 28.3 (3.7) cm, respectively. The prevalence  
173 of BMI <18.5 kg/m<sup>2</sup> to determine undernutrition was 30%. Prevalence of MUAC < 21 cm and CC <  
174 31 cm was 23% and 73%, respectively (Table 2).

175 Mean (SD) FVS, DDS and DSS of the study population were 8.7 (1.5), 7.3 (1.2) and 10.9 (2.0),  
176 respectively, with similar mean values in men and women, respectively, for FVS (8.8 (1.5) and 8.5  
177 (1.5)), DDS (7.4 (1.1) and 7.2 (1.2)) and DSS (10.8 (1.9) and 11.0 (2.1)). Undernourished subjects  
178 had a lower median DSS compared with nourished counterparts. The nourished elderly had  
179 maximum of 16 DSS, whereas in the undernourished elderly it was approximately 13.

180 Mean daily intakes of fruit, vegetable, meat, fish, eggs and pulses and dairy were below the national  
181 recommendations for a Sri Lankan population (Table 3), whereas the mean consumption of sugar  
182 appeared to exceed the national recommendation. Only the mean intake of starch was within the  
183 recommendations (Table 3).

184 Food allergies, skipping meals and lack of leisure activities significantly increased the risk of  
185 undernutrition, whereas the use of dentures decreased the risk in both univariable and multivariable  
186 logistic regression analyses (Table 4).

## 188 Discussion

189 Numerous risk factors for undernutrition among the elderly have been identified, with many studies  
190 performed in developed countries where the ageing population is escalating. However, there is an  
191 urgent need for these risk factors to be pre-tested and modified if required for application in Asian  
192 populations since there are apparent differences in anthropometric indicators, lifestyle and food  
193 patterns among different ethnic groups. Both the risk factors and prevalence of undernutrition  
194 among institutionalised elderly people in Sri Lanka remain poorly understood.

195 In the present study, the institutions studied were non-paying homes for the elderly. The majority  
196 were managed by religious and non-government organisations, philanthropic families or trusts,  
197 whilst others were financially assisted by the Ministry of Social Services of Sri Lanka. The food  
198 offered to the residents was prepared by the institution, with the exception of food provided by  
199 visitors on special occasions. The majority of the institutions had set menus for three daily meals,  
200 which were not prepared with nutrition requirements or dietary diversity considerations. The variety  
201 of foods offered on the menus was dependent on the financial resources of the institution. The  
202 current study demonstrated that undernutrition is common among a representative sample of



institutionalised elderly residents across Sri Lanka. Using BMI as a useful approximate anthropometric indicator to determine undernutrition in elderly<sup>(22)</sup>, nearly one-third (30%) of the studied residents were identified as being undernourished, with a similar prevalence among men (28.6%) and women (31.6%). According to the WHO cut-offs<sup>(15)</sup>, 23% of the institutionalised elderly in this study had a lower MUAC than recommended if sufficiently nourished, which suggests declining muscle mass and fat stores. Sarcopenia, which is the decline in muscle mass, is a major physiological condition that is predominantly found with increasing aging. Although the aetiology of sarcopenia remains unclear, physical inactivity, inadequate dietary protein and/or impaired protein utilisation have been identified as indirect factors that contribute to declining muscle mass<sup>(23)</sup>. In this study group, protein-rich food consumption was below the national recommendations. Additionally, based on the cut-off defined from the MNA tool<sup>(17)</sup>, 74% had CC of  $\leq 31$  cm. Previous studies identified CC as a potential marker of physical function, which provides valuable information on muscle-related disability and physical function<sup>(16)</sup>. High prevalence of low CC showed weakness in leg strength and physical function in this population.

Dietary diversity, used as a simple tool to identify those at risk of food and nutrition insecurity<sup>(24, 25)</sup> and as a marker of population micronutrient status<sup>(21)</sup>, was assessed using three measures: FVS, DDS and DSS. A recent study conducted in Sri Lanka demonstrated that FVS, DDS and DSS were useful proxy indicators of nutrient adequacy of elderly people<sup>(26)</sup>. Macro- and micronutrient deficiencies are public health concerns in Sri Lanka due to the monotonous, cereal-based diets that lack diversity. Several studies have shown that the overall nutritional quality as well as nutrient adequacy of the diet is improved with a diverse diet<sup>(27-30)</sup>. DDS is a major element of a high quality diet as it represents the variety of the diet. In the current study, none of the dietary diversity measures of the study sample met the optimum level (DDS was approximately 7 out of 12 food groups considered) suggesting that both the quality and quantity of their diets were poor. Only cereal consumption was within the recommendations. Noticeably, consumption of fruits, vegetables, dairy and animal foods were substantially lower than the minimum national recommendations. Since the quality and quantity of the diet is inadequate, there is a higher tendency of developing both macro- and micronutrient deficiencies among the study sample. When comparing the dietary diversity indicators (FVS, DDS and DSS) of undernourished and nourished elderly people, there was no significant difference in terms of FVS and DDS. However, as expected, the DSS of the undernourished elderly was less than that of nourished elderly. Although the number of different food groups consumed by both the undernourished and nourished elders was similar, the diversity of different food groups consumed by the undernourished elderly was less than that of the nourished elderly. Moreover, consumption of fruits, both fruits and vegetables, meat, fish and egg portions per day were relatively low among the undernourished elderly than the nourished elderly.

238 The nutrition and behaviour risk factors associated with the prevalence of undernutrition in the  
 239 institutionalised elderly from this study were in line with those of previous studies<sup>(31-33)</sup>. The elderly  
 240 who experienced a loss of appetite were 2.2 times more likely to be undernourished than those who  
 241 retained their appetite. There are many mechanisms by which appetite loss might confer an  
 242 increased risk of undernutrition among the elderly. Studies have reported that with increasing age,  
 243 the ability to visualise, smell and taste foods decreases<sup>(34, 35)</sup> and there are distinct changes in  
 244 gastrointestinal function, which likely reduces motility rates and disrupts digestion or absorption<sup>(9,  
 245 36, 37)</sup>. All of these age-related changes are associated with an increase in the satiety hormone  
 246 cholecystokinin and a reduced feeding drive, both of which result in a loss of appetite<sup>(38)</sup>.  
 247 Supportive of previous literature<sup>(33)</sup>, the present study observed that skipping meals was  
 248 significantly associated with a 3.8 times higher OR of being undernourished. Having food allergies  
 249 was also identified as a risk factor for undernutrition having an OR of 8.0. The association of  
 250 undernutrition in the elderly with psychological factors is of growing interest. **Although**  
 251 **multivariate analysis did not show a significant effect, the possibility that symptoms of depression**  
 252 **may exist.** Symptoms of depression (a lack of interest and pleasure in life) was associated with a 2.6  
 253 fold higher risk of undernutrition **in univariable analysis**, which supports previous work<sup>(31)</sup>.  
 254 Loneliness is associated with negative factors, including boredom, restlessness and unhappiness,  
 255 and ultimately leads to a decrease in food intake. Results of the present study indicate that a lack of  
 256 leisure activities was associated with 3.2 times higher risk for undernutrition, which is comparable  
 257 with previous findings<sup>(39)</sup>. Indeed, we found that the use of dentures was associated with less  
 258 undernutrition in elderly. In line with our findings, a recent study reported a positive association  
 259 between both tooth loss and denture status and being underweight in the older elderly from Sri  
 260 Lanka<sup>(32)</sup>.  
 261 The strength of this study was its diversity of homes for elders in Sri Lanka, representing six out of  
 262 the nine provinces in the country. Although a single day food record cannot be used to accurately  
 263 evaluate an individual's habitual dietary intake, 24-h dietary recalls provides an estimate of the  
 264 nutrition status of the elderly population studied. Indeed, there may be biases when taking 24-h  
 265 dietary recalls from the elders because of their memory lapses, however, in the current study, ,  
 266 visual recognition aids were used, as well as commonly used household measures to minimise the  
 267 recall biases<sup>(40)</sup>. Oil and fats were not estimated in this study. Coconut fat is the major contributor of  
 268 dietary fat in Sri Lankan diets, and since coconut oil, coconut milk and/or scraped coconuts are  
 269 added into composite dishes, this would have led to methodological challenges in obtaining  
 270 accurate intakes of fats and oils<sup>(41)</sup>. The MNA is one of the most widely used tools for assessing  
 271 malnutrition in the elderly but has limitations in its application for non-Western and non-Caucasian  
 272 populations<sup>(42)</sup>. Therefore, the modification of nutrition assessment tools according to different

273 populations is recommended to effectively assess the nutrition status of the elderly in both the  
274 developed and developing countries.

275

## 276 **Conclusion**

277 The prevalence of undernutrition, as determined by BMI, in the institutionalised elderly in Sri  
278 Lanka was high, and both the quantity and quality of diets failed to meet national recommendations.  
279 Food allergies, skipping meals and lack of leisure activities all significantly contributed to  
280 undernutrition. This high degree of undernutrition identified in the current study emphasises the  
281 need for the development of a tool specific to the Sri Lankan elderly population to detect the  
282 emerging nutrition problems and to allow a timely intervention to prevent the occurrence of severe  
283 undernutrition in this vulnerable group.

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**Table 1 Socio-demographic characteristics of the institutionalised elderly Sri Lankan population**

<b>Characteristic</b>	<b>All % (n)</b>	<b>Men % (n)</b>	<b>Women % (n)</b>
<b>Gender</b>	100 (311)	45 (140)	55 (171)
<b>Age</b>			
60-69 years	28 (87)	14 (44)	14 (43)
70-79 years	44 (137)	17 (53)	27 (84)
>80 years	28 (87)	14 (43)	14 (44)
<b>Level of education</b>			
No schooling	32 (99)	9 (29)	23 (70)
Up to Grade 5	31 (96)	16 (50)	15 (46)
Up to Grade 10	31 (97)	17 (52)	14 (45)
G.C.E. O/L and above	6 (19)	3 (9)	3 (10)
<b>Financial assistance</b>			
Yes	20 (63)	9 (30)	11 (33)
No	80 (248)	35(110)	45 (138)
<b>Number of years a resident</b>			
1- 5 years	66 (204)	31 (96)	35 (108)
6-10 years	24 (74)	10 (32)	14 (42)
> 10 years	10 (33)	4 (12)	6 (21)
<b>Mobility</b>			
Active (walk actively)	52 (159)	25 (75)	27 (84)
Less active (walk using aids)	41 (129)	17 (53)	24 (76)
Inactive (walk with assistance)	7 (23)	4 (12)	3 (11)
<b>Presence of chronic diseases</b>			
Yes	59 (182)	22 (68)	37 (114)
No	41 (129)	23 (72)	18 (57)
<b>Presence of acute illness</b>			
Yes	19 (59)	11 (33)	8 (26)
No	81 (252)	34 (107)	47 (145)
<b>Use of medication</b>			
Yes	66 (206)	26 (82)	40 (124)
No	34 (105)	19 (58)	15 (47)
<b>Betel chewing</b>			
Yes	37 (115)	21 (64)	16 (51)
No	63 (196)	24 (76)	39 (120)

**Table 2 Anthropometric characteristics of the study population**

<b>Factor</b>	<b>Mean</b>	<b>SD</b>	<b>% (n)</b>
<b>BMI (kg/m<sup>2</sup>)</b>	<b>21.5</b>	<b>4.8</b>	-
<18.5	16.6	1.4	<b>30</b> (94)
≥18.5	23.6	4.1	70 (217)
<b>MUAC (cm)</b>	<b>23.4</b>	<b>3.5</b>	-
<21	19.4	1.3	<b>23</b> (72)
≥21	24.6	3.0	77 (239)
<b>CC (cm)</b>	<b>28.3</b>	<b>3.7</b>	-
<31	26.7	2.7	<b>74</b> (229)
≥31	32.8	2.1	26 (82)

CC, calf circumference; MUAC, mid-upper arm circumference



**Table 3 Comparison of mean food intake by food groups of the study population with national Sri Lankan dietary recommendations**

<b>Food Groups</b>	<b>Mean intake (portions/d)</b>	<b>National recommendation (portions/d)*</b>
Cereal or equivalents (starchy foods)	8.24	6-11
Fruits	0.46	2-3
Vegetables	1.49	3-5
Fruits & vegetables	1.95	≥ 5
Meat, fish, eggs and pulses	1.56	3-4
Dairy (milk and/or milk products)	0.55	1-2
Added sugar	3.71	Sparingly

\*Food-based dietary guidelines for Sri Lankans<sup>(19)</sup>

**Table 4 Factors associated with undernutrition in elderly**

Factors	Univariable analysis		Multivariable analysis		
	OR	P value	OR	P value	95% CI <sup>a</sup>
Skipping meals	6.08	<0.0001	<b>3.84</b>	<b>&lt;0.0001</b>	<b>1.971, 7.500</b>
Food allergies	10.16	<0.001	<b>8.01</b>	<b>&lt;0.0001</b>	<b>3.948, 16.236</b>
Loss of appetite	2.19	0.002	1.55	0.167	0.833, 2.876
Lack of leisure activities	3.78	<0.0001	<b>3.19</b>	<b>0.002</b>	<b>1.517, 6.703</b>
Lack of pleasure or interest (Symptoms of depression)	2.61	<0.0001	1.19	0.592	0.634, 2.222
Wearing dentures	0.28	0.019	<b>0.20</b>	<b>0.011</b>	<b>0.057, 0.694</b>

\* CI, P values and OR were obtained from corresponding multivariable binary logistic regression analysis. Significant values in multivariable binary logistic regression analysis are given in bold type.